



The MONITOR

Aeronautical Systems Center (ASC/ENVV)

Vol. 8, No. 10, Summer 2004/AFMC Public Release Number 0704

Bldg 8 • 1801 Tenth St • Suite 2 • WPAFB, OH 45433-7626 • Commercial: (937) 255-3566 • DSN: 785-3566 • Fax: (937) 255-4155



Sustaining



Solutions



for the



Warfighter



Table of Contents...

"Which Came First - The Chicken or the Egg?" - Reducing Hazardous Materials Use Across Industrial Processes & Weapon Systems	3
Who's Who in Weapon System Pollution Prevention	5
Overview of Air Force Materiel Command Pollution Prevention Integrated Product Team (AFMC P2IPT) Funded Projects	10
The Propulsion Environmental Working Group (PEWG): An Industry and Government Collaboration to Green the Military Propulsion Industrial Base	12
PEWG Success Story: Qualification of HVOF Thermal Spray Coatings to Replace Hard Chrome Plating in Gas Turbine Engine Manufacture and Repair	15
Warner Robins Air Logistics Center is Leaning Industrial Processes with Pollution Prevention	16
Success with Cadmium Separator for Aircraft Washrack	20
Air Force Plant 44 Supercritical Carbon Dioxide Success Story	21

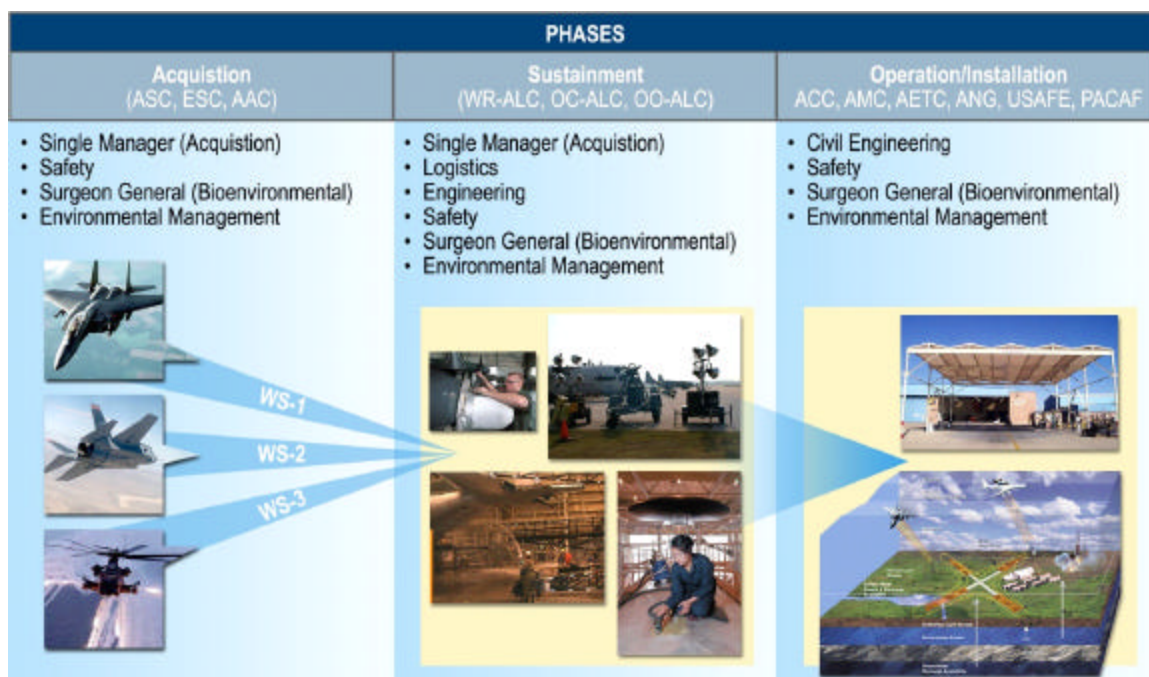
The MONITOR is a quarterly publication of the Headquarters Air Force Materiel Command (AFMC) Pollution Prevention Integrated Product Team (P2IPT) dedicated to integrating environment, safety, and health related issues across the entire life cycle of Air Force Weapon Systems. AFMC does not endorse the products featured in this magazine. The views and opinions expressed in this publication are not necessarily those of AFMC. All inquiries or submissions to the MONITOR may be addressed to the Program Manager, Mr. Frank Brown.

**Aeronautical Systems Center
(ASC/ENVV)**

Bldg. 8 • 1801 Tenth Street • Suite 2 • Wright-Patterson AFB, OH 45433-7626
Commercial: (937) 255-3566
DSN: 785-3566
FAX: (937) 255-4155

“WHICH CAME FIRST – THE CHICKEN OR THE EGG?” – REDUCING HAZARDOUS MATERIALS USE ACROSS INDUSTRIAL PROCESSES & WEAPON SYSTEMS

Which came first – the chicken or the egg? This dilemma has been much debated, and often, the answer to this seemingly simple question, lies in one’s perspective. The same holds true when implementing pollution prevention solutions. Do you try to eliminate the use of hazardous materials in the product (aircraft) or in the process (plating line)? Again, your answer may differ depending on whether your primary role is to support the aircraft during its acquisition, sustainment, or operational phase, and whether your primary responsibility resides in the acquisition, safety, bioenvironmental, environmental management, logistics, engineering, or civil engineering community.



Product vs. Process - A Complex Situation

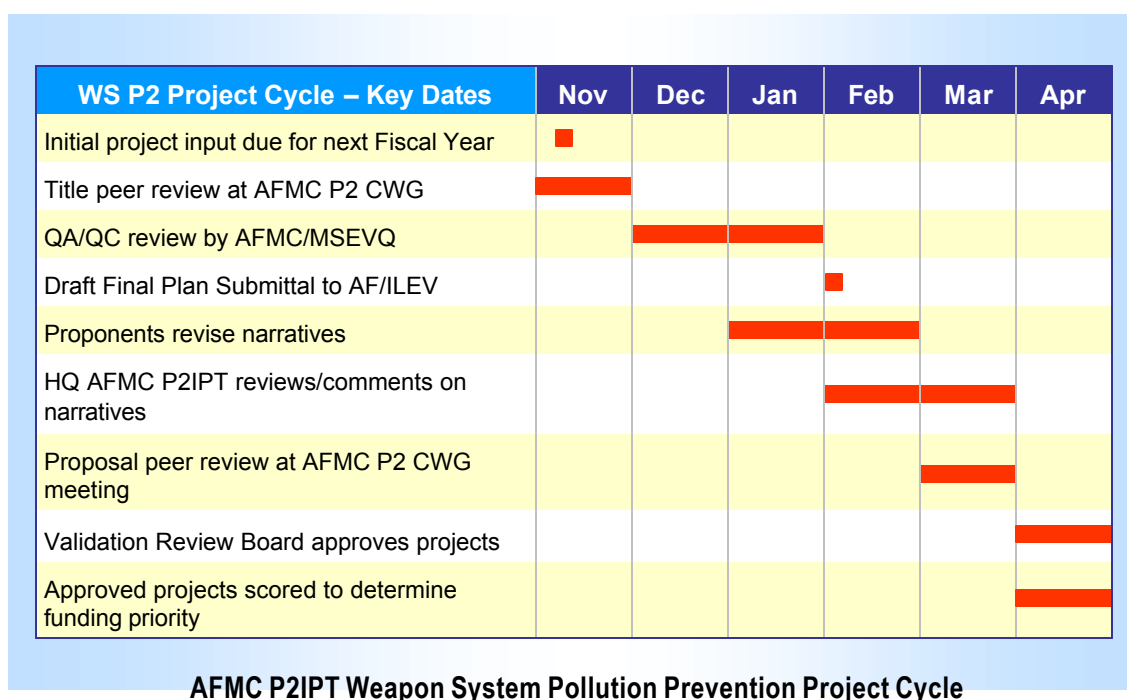
In this complex situation, do you focus on the product or the process? Formation of chartered cross-functional teams that bring together all potential stakeholders is a central element to solution implementation. For pollution prevention, these groups solve “the chicken or the egg” dilemma by transcending difference for a common goal - reducing the use of hazardous materials through implementation of sustaining solutions for the warfighter.

Some of the organizations that facilitate the reduction of hazardous materials use across the Air Force industrial processes and weapon systems are described on [pages 5](#) through [10](#) of this issue. The Air Force Materiel Command Pollution Prevention Integrated Product Team (AFMC P2IPT) and the AFMC Pollution Prevention Center Working Group (AFMC P2 CWG) are two key teams that support the AFMC Pollution Prevention Program. The AFMC P2IPT annually approves demonstration/validation projects for funding, with the AFMC P2 CWG providing peer review of projects for the upcoming year (see figure on [page 4](#) for the funding cycle). A description

of some of the demonstration/validation projects recently funded by the AFMC P2IPT is provided on [pages 10 to 12](#).

One of the sustaining solutions supported by AFMC is High Velocity Oxygen Fuel (HVOF) thermal spray coating, which has the widest range of applications for replacing hard chrome coatings in aerospace military and commercial applications. For the bioenvironmental community, this solution

depots and the original equipment manufacturers to demonstrate and validate HVOF for various applications and to build HVOF facilities. A major factor for this successful transition has been the funding provided by the Environmental Security Technology Certification Program (ESTCP), which helped to leverage additional funds from other sources. Today, HVOF spray booths have or are being installed at all the AF logistics centers as an alternative to chrome plating (see article on [page 15](#) for



reduces worker exposure to chromium, a carcinogen. For the engineering and logistics communities, HVOF is anticipated to last twice as long as chrome coatings. For the environmental community, HVOF coatings reduce the compliance burden associated with chrome plating.

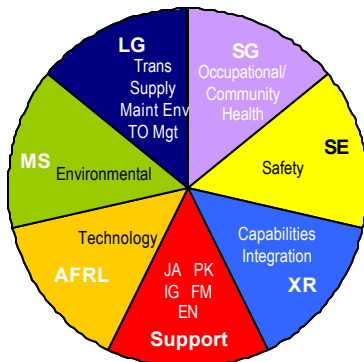
Since 1996, the Hard Chrome Alternatives Team (HCAT), the Propulsion Environmental Working (PEWG), and others have been working with the

transition of HVOF to gas turbine engines).

In summary, the key elements for reducing the use of hazardous materials across the AF industrial processes and weapon systems involve identifying sustaining solutions, forming partnerships and/or working groups to champion a technology, and getting the initial demonstration/validation funded. ■

WHO'S WHO IN WEAPON SYSTEM POLLUTION PREVENTION

Air Force Materiel Command, Pollution Prevention Integrated Product Team (AFMC P2IPT)
 – <https://www.hqafmc.wpafb.af.mil/p2ipt/index.html>



The AFMC P2IPT reports to the AFMC Environmental Safety and Occupational Health (ESOH) Committee and addresses cross-functional pollution prevention issues, reviews status of weapon system projects, and approves weapon system projects for potential funding. The AFMC P2IPT is chaired by AFMC/MSEVQ and meets bi-monthly. The core members of the team include Mission Support (MS), Logistics (LG), Surgeon General (SG), Safety (SE), Air Force Research Laboratory (AFRL), and Capabilities Integration (XR). The HQ AFMC P2IPT core members include the following:

- AFMC/MSEVQ & AFMC P2IPT Chair: Ed Finke (Edward.Finke@wpafb.af.mil);
- AFMC/LGPE: Tom Spitler (Thomas.Spitler@wpafb.af.mil) and Linda Willis (Linda.Willis@wpafb.af.mil);
- AFMC/SGPE: Major Carolyn Macola (Carolyn.Macola@wpafb.af.mil);
- AFMC/SEG: Bob McAllister (Robert.McAllister@wpafb.af.mil);
- AFRL/MLSC: Tom Naguy (Thomas.Naguy@wpafb.af.mil) and Major Cliff Thorstenson (Clifford.Thorstenson@wpafb.af.mil);
- AFMC/XRQ: Penny Kretchmer (Penny.Kretchmer2@wpafb.af.mil).

Additional details about the key organizations supporting the AFMC P2IPT are also available at the above website.

Air Force Materiel Command Weapon System Pollution Prevention Center Working Group (AFMC P2CWG) – <https://www.hqafmc.wpafb.af.mil/p2ipt/index.html>



The AFMC Weapon System Pollution Prevention Center Working Group (AFMC P2 CWG) is the command forum to resolve common weapon system pollution prevention problems. The AFMC P2 CWG is chartered by the HQ AFMC P2IPT. Since its inception, the group has hosted over 20 meetings. Information regarding upcoming meetings is available on the above website or by contacting Lori Sargeant (Lori.Sargeant@wpafb.af.mil).

The core members of the AFMC P2 CWG include representatives from other major commands, AFMC P2IPT, product, test, and air logistics centers. The current members include the following:

- HQ AFMC/LGP & AFMC P2 CWG Chair: Debbie Meredith (Debra.Meredith@wpafb.af.mil);
- HQ AFMC/MSEVQ: Ed Finke (Edward.Finke@wpafb.af.mil);
- HQ AFMC/SEG: Bob McAllister (Robert.McAllister@wpafb.af.mil);
- AFMC/SGPE: Major Carolyn Macola (Carolyn.Macola@wpafb.af.mil);
- AFRL/MLSC: Tom Naguy (Thomas.Naguy@wpafb.af.mil);
- AFMC/XRQ: Penny Kretchmer (Penny.Kretchmer2@wpafb.af.mil);

- ASC/ENV: Alex Briskin (Alex.Briskin@wpafb.af.mil);
- ESC/AE: Peter Logan (Peter.Logan@hanscom.af.mil);
- AFFTC/EM: Hans Beutelman (Hans.Beutelman@edwards.af.mil);
- AFSPC/CEV: Dean Dunn (Dean.Dunn@peterson.af.mil);
- OC-ALC/EM: Bede Ley (Bede.Ley@tinker.af.mil);
- OO-ALC/EM: Craig Shaw (Craig.Shaw@hill.af.mil);
- WR-ALC: Richard Slife (Richard.Sliffe@robins.af.mil); Dave Bury (Dave.Bury@robins.af.mil);
- ACC/LG-EM: Bruce Stephens (Bruce.Stephens@langley.af.mil);
- AETC-LG/LG-EM Member: MSgt Tim Walters (Timothy.Walters@randolph.af.mil).

Joint Group on Pollution Prevention (JG-PP) - <http://www.jgpp.com>



The JG-PP's objective is to execute a standard business and technical process for joint service/agency pollution prevention projects to minimize duplication of effort when solving common requirements. The JG-PP is chartered by the Joint Logistics Commanders (JLCs) to reduce or minimize the use of hazardous materials and processes across the acquisition and sustainment communities. Technical information and management updates for all JG-PP executed and monitored projects are available on the above website. The website is updated monthly.

JG-PP membership includes all DoD services, Defense Logistics Agency (DLA), Defense Contract Management Agency (DCMC), and National Aeronautics and Space Administration (NASA). Senior Leadership support to this group is provided by the JG-PP Principals, which consist of senior flag officers from all services/agencies. The current representatives to the JG-PP Working Group include the following:

- Air Force: Patricia Jordan (Partricia.Jordan@wpafb.af.mil);
- U.S. Marine Corps and JG-PP Working Group Chair: Gary Leitner (Gary.Leitner@usmc.mil);
- Navy: Andy Del Collo (Andy.Delcollo@navy.mil);
- Army: Maryalice Miller (maryalice.miller@us.army.mil);
- NASA: Christina Brown (christina.m.brown@nasa.gov);
- DCMC: David James (david.james@dcmc.mil).

Propulsion Environmental Working Group (PEWG) - <http://www.pewg.com>



The PEWG is chartered by the DoD Joint Propulsion Coordinating Committee (JPCC) to address environmental security issues for gas turbine engines. The current JPCC membership includes the Air Force, Navy, Army, NASA, and the Coast Guard. The PEWG members nominate projects that can reduce duplication through a joint investigation, testing, and qualification effort. The PEWG membership consists of JPCC organizations, engine manufacturers, suppliers, and other stakeholders. The group hosts bi-annual meetings to discuss critical issues and provide project updates. The next meeting has been scheduled

from 24-28 January 2005, with the location yet to be determined. Registration and details about upcoming meetings are available on the above website.

Lynda Waring, ASC/LP, currently chairs the PEWG for the Air Force. The PEWG is recognized as a special management organization under AFI-21-104. The PEWG Management Team Leader is Mary Swinford (Mary.Swinford@wpafb.af.mil).

Hard Chrome Alternatives Team (HCAT) - <http://www.hcat.org>



The HCAT executes a demonstration/validation program to replace the use of hard chrome at the original equipment manufacturer (OEM) and depot level, and in commercial applications. The US Team focuses on replacing chrome plating in the Department of Defense

(DoD) repair depots on a variety of aircraft and gas turbine engine components and a Canadian team focuses on replacing chrome on commercial and military landing gear. The HCAT is funded from various sources including the Environmental Security Technology Certification Program (ESTCP) and has coordinated the execution of many projects to transition high velocity oxygen fuel (HVOF) thermal spray technology. The Team received the ESTCP Project of the Year Award in 2003 for the project on Hard Chrome Plating Replacement with HVOF Thermal Spray Coatings on Landing Gear Project. The above website has a work space where project data and reports are made available to the more than 400 individuals on the HCAT distribution list. The HCAT teams host bi-annual meetings where test results and technology insertion issues are discussed. Information on upcoming HCAT Meetings is available on the above website.

Bruce Sartwell, from the Naval Research Laboratory (sartwell@nrl.navy.mil), is the HCAT US Team Lead.

DoD Corrosion Exchange - <http://www.dodcorrosionexchange.org>

Public Law 107-314 requires DoD to develop and implement a long-term strategy to reduce the effect of corrosion on military equipment and infrastructure. The DoD Corrosion Forum addresses this requirement and consists of core members from each service. The Air Force Corrosion Program Office is the AF representative to this forum.

The corrosion exchange establishes a platform for members to communicate and share information. All members are required to register for complete access to the website.

AFRL/MLS-OLR: Air Force Corrosion Program Office – <https://afcpco.robins.af.mil>



AFRL/MLS-OR manages the Air Force's Corrosion Prevention and Control Program. The Air Force Corrosion Prevention and Control Office (AFCPCO) is the Air Force's single focal point for all corrosion guidance and policy. The office is responsible for maintaining eight AF wide Technical Orders (TOs) and conducts corrosion field surveys every five years. The AFCPCO's customers include Air Force field units, command-level corrosion managers, depots, and system program managers. The Office hosts a Corrosion Conference annually in Macon, GA. The next Corrosion Conference will be held on 14-18 March 2005.

Additional information about the conference can be found at <http://www.afcpo.com>. AFCPO is also the AF representative to the DoD Corrosion Forum and supports the Corrosion Prevention Advisory Boards (CPABs) for each weapon system.

AFLR/MLS-OLR Chief: Major Robert Reed (Robert.reed@robins.af.mil)

AFRL/MLSSO: Air Force Coating Technology Integration Office - <http://www.ml.af.mil/ctio/default.html>



AFRL/MLSSO manages the Air Force Coating Technology Integration Office (CTIO). The office serves as the Air Force's central resource for aircraft coating systems and their applications. The CTIO's primary objective is to improve coating system performance through the integration and transition of environmentally acceptable materials and processes for aircraft refinishing.

Besides performing material specification testing where the coatings are applied under ideal conditions, the CTIO applies coatings under varying temperatures and humidities that are experienced at depot and field level facilities. To comply with Air Force Acquisition Reform, the CTIO has certified their facility to ISO 17025 and AS 5505. This allows their data to be accepted by the SAE G-8 Aerospace Coatings Subcommittee for the purposes of qualification to Aerospace Materials Specifications (AMS).

Information about the CTIO facility is provided on the above website. Additionally, the website provides information on the CTIO projects executed in depainting, primer application, surface preparation and topcoat application.

AFRL/MLSSO Chief: Mike Spicer (Mike.Spicer@wpafb.af.mil)

ASC/ENVV: Aeronautical Systems Center, Pollution Prevention Branch - <https://www.en.wpafb.af.mil/env/envv.asp>



ASC/ENVV is responsible for reducing environment, safety, and health (ESH) burden to the weapon system acquisition process through implementing pollution prevention solutions and business practices. ESH support to the System Program Offices (SPOs) is provided by a home office team and co-locates assigned to the B-1/B-2, C-17, JSF, Air Combat SPO (includes F-15/F-117), F-16, F/A-22, Reconnaissance SPO, Mobility SPO, Propulsion SPO, Special Operations Force (SOF) SPO, Training SPO, and Aging Aircraft SPO. ASC/ENVV hosts a monthly co-locate cross-feed meeting for all ESH SPO Managers.

ASC/ENVV is the winner of the 2003 General Thomas D. White Award for Acquisition Pollution Prevention and the 2003 Secretary of Defense Environmental Award for Environmental Excellence in WS Acquisition. The Thomas D. White award recognizes the team that contributed the most to the Air Force's efforts to preserve and enhance the environment during the two previous years through work in the area of pollution prevention in weapon system acquisition. This DoD

Environmental Award recognizes the achievements of the total ASC Pollution Prevention team in protecting the environment as part of the overall DoD mission.

The ASC/ENVV Acting Branch Chief is Alex Briskin (Alex.Briskin@wpafb.af.mil) and the current ESH Managers in the SPOs include the following:

- B-1/B-2: Tim Kalt (Timothy.Kalt@wpafb.af.mil/Timothy.Kalt2@wpafb.af.mil);
- C-17: Major Carolyn Jacobson (Carolyn.Jacobson@wpafb.af.mil);
- ACC SPO: Angela Klein (Angela.Klein@wpafb.af.mil);
- F-16: Mary Wyderski (Mary.Wyderski@wpafb.af.mil);
- F/A-22: Jared Scott (Jared.Scott@wpafb.af.mil);
- Reconnaissance SPO: Amy Mercado Vince (Amy.Vince@wpafb.af.mil);
- Mobility SPO: John Stallings (John.Stallings@wpafb.af.mil);
- SOF SPO: Lavera Floyd (Lavera.Floyd@wpafb.af.mil);
- Training SPO: Alexei Lozada-Ruiz (Alexei.Lozada-Ruiz@wpafb.af.mil).



ASC/ENVV Team - Winner of the 2003 Secretary of Defense Environmental Award for Environmental Excellence in WS Acquisition

ESC/AE: ESC Weapon System Environmental Division - <http://esc.hanscom.af.mil/ESC%2DBP/pollprev/>



The goal of the ESC weapon system environmental process is to reduce or eliminate environmental risks and burden by integration of ESH into the systems engineering process. This goal is accomplished through an Environmental Working Group (EWG) that is chaired by ESC/AE and includes members from all appropriate functional areas and the SPOs. The EWG raises awareness of ESH regulatory requirements in program execution and through participation in other groups, such as the AFMC P2 CWG, brings new tools & concepts to the SPOs. The ESC website provides information and various tools to support the SPOs, including a Programmatic Environmental Safety and Health Evaluation (PESHE) that is routinely updated, as the requirements change.

ESA/AE Branch Chief: Peter Logan (Peter.Logan@hanscom.af.mil)

Warner Robins Air Logistics Center, Environmental Management Directorate (WR-ALC/EM) - <https://www.mil.robins.af.mil/em/>



The WR-ALC/EM plans, programs, and implements the installation's environmental protection program for the center, wing, and hosted units at Robins AFB. The Directorate is responsible for all aspects of environmental management, including pollution prevention, conservation, restoration, and compliance.

The above website contains information on the key Directorate Programs, including the Toxic Release Inventory Development (TRIAD). This Program provides a systematic approach to finding solutions for most widely used toxic release inventory chemicals, ozone depleting substances, and hazardous air pollutants at the installation, where the weapon system manager is the primary decision maker.

WR-ALC/EM is the winner of the 2003 Secretary of Defense Environmental Award for Pollution Prevention-Industrial Installation. WR-ALC/EM's initiative to incorporate pollution prevention with lean logistics (see related article on [page 16](#)) was an important factor in this recent win. Weapon System Pollution Prevention contacts include the following:

- WR-ALC /EM Director: Steve Coyle (Steven.Coyle@robins.af.mil)
- WR-ALC/EM Pollution Prevention Program Manager: Dave Bury (Dave.Bury@robins.af.mil);
- WR-ALC/MAPE, Maintenance Directorate Environmental and Safety Compliance Branch Chief: Richard Slife (Richard.Sliffe@robins.af.mil). ♦

OVERVIEW OF AIR FORCE MATERIEL COMMAND POLLUTION PREVENTION INTEGRATED PRODUCT TEAM (AFMC P2IPT) FUNDED PROJECTS

This article gives a brief overview of the recently funded projects by Air Force Materiel Command Pollution Prevention Integrated Product Team (AFMC P2IPT). These projects are also currently being incorporated into the AFMC *Solutions Database*.

AFRL/MLSC - Evaluate Cold Spray Coatings

(AFRL04W193): The purpose of this project is to evaluate commercially available Cold Spray technologies for the application of

Air Force Materiel Command's
AFMC'S
SOLUTIONS DATABASE

- AFMC's Information Exchange for Pollution Prevention Technology
- Contains information on over 300 AF System Program Funded Pollution Prevention Projects.
- Web Enabled for Project Updates
 Website: https://www.en.wpafb.af.mil/p2_solutions/p2_solutions.asp

Contact: Frank Brown, ASC/ENVV at Frank.Brown@wpafb.af.mil to submit information for inclusion in the database.

* Funded by the HQ AFMC Pollution Prevention Integrated Product Team (P2IPT)

Tungsten Carbide Cobalt (WC-Co). The primary focus will be to demonstrate that Cold Spray coatings will not delaminate and spall as do HVOF applied coatings when subjected to stresses at the higher levels of the substrate operating range. Contact Tom Naguy, AFRL/MLSC, at Thomas.Naguy@wpafb.af.mil.

AFRL/MLSC - Low Cost High Performance Electrical Brake System for Unmanned Aerial Vehicles (AFRL04W201): The purpose of this project/program is to demonstrate a low-cost and high performance electromechanical brake system adaptable for a range of medium-weight Unmanned Aerial Vehicles (UAVs). The use of such a system will eliminate the need for hydraulic fluid and hoses, considerably simplifying both vehicle manufacture and end-of-life recycling and eliminating fluid disposal issues. Contact Tom Naguy, AFRL/MLSC, at Thomas.Naguy@wpafb.af.mil.

AFRL/MLSC - Prototype Ultra Violet (UV) Cure Paint Repair Coatings (AFRL04W203): Foster-Miller, Inc. is developing a 100 % reactive, non volatile organic compound, UV-curable aircraft repair patch coating to replace the two-component, solvent-borne polyurethane coating currently used to repair damaged areas of US Air Force aircraft. This project will implement a solution to address the current problems associated with aircraft repair of patch topcoats. Contact Tom Naguy, AFRL/MLSC, at Thomas.Naguy@wpafb.af.mil.

WR-ALC/EM - Demonstrate/Validate Alternatives to Marsol in Tank/ System Clean (UUAZ031310): This project continues the effort to qualify and demonstrate/validate alternatives to Marsol used to clean integral fuel tanks. Marsol is a Type 1 hazardous air pollutant (HAP) based cleaner that contains toluene, MEK, naphtha, ethyl acetate, and isopropyl alcohol used on F-15 and C-130. Contact Dave Bury, WR-ALC/EM, at Dave.Bury@robins.af.mil.

ASC/ENVV - Qualify Plural Component Paint Dispensing System (AFMC04PV48): This project will qualify two distinct plural painting units for full scale C-130 production at OO-ALC. One unit will be installed in the C-130 paint booth and one will be used for out-of-sequencing painting performed in the maintenance hanger. Contact Chuck Valley, ASC/ENVV, at Charles.Valley@wpafb.af.mil.

ASC/ENVV - Qualify HVOF Coating on F/A-22 Landing Gear (AFMC04PV43): This project will continue to fund the qualification test effort to place High Velocity Oxygen Fuel (HVOF) coating on the F/A-22 Landing Gear. Hard Chrome is the current baseline coating for the F/A-22 landing gear and is used on many critical components. Contact Jared Scott, F/A-22, at Jared.Scott@wpafb.af.mil.

ASC/ENVV - Qualify Advanced Thermal Spray Coatings for GTE Applications – III (AFMC04LP38): This project will qualify HVOF thermal spray for use in depot repair of military gas turbine engines. The project is being worked in conjunction with the US/Canadian Hard Chrome Alternative Team (HCAT) and the DoD Environmental Security Technology Certification Program (ESTCP). The current effort is focused on the TF33 engine and once qualified, will expand to F100

and other Pratt & Whitney engines. HVOF Thermal Spray has the potential to be applied to at least 60% of engine parts currently electroplated. The estimated reduction of chrome electroplating at OC-ALC on the TF33 engine parts is 40% annually (see related article on [page 15](#)). Contact Mary Swinford, PEWG, at, Mary.Swinford@wpafb.af.mil.

AFP6 - Implement on-Demand Decal Printing System (ACFL04PV19): This project will qualify materials and vendors for implementing an on-demand or ready-made decal system using thermal transfer, jet printing, or some other suitable process. This project will develop company-wide common material and process specifications for decal applications; qualify common, readily available decal materials to the material specifications; modify engineering as needed to accommodate graphics, job instructions, and certify vendors and/or machines for supply of decals. Contact Dave Maddox, ASC/ENVC at David.Maddox@wpafb.af.mil. ●

THE PROPULSION ENVIRONMENTAL WORKING GROUP (PEWG): AN INDUSTRY AND GOVERNMENT COLLABORATION TO GREEN THE MILITARY PROPULSION INDUSTRIAL BASE

What is the PEWG?

The Propulsion Environmental Working Group (PEWG) is an established competency within the Department of Defense (DoD) propulsion community to respond to gas turbine fleet environmental security issues and opportunities. The PEWG has operated under a charter from the DoD Joint Propulsion Coordinating Committee (JPCC) since 1992.

The JPCC was initially formed in February 1988 to promote cooperation, standardization, and synergy among key players concerned with gas turbine engine excellence. In 1994, the JPCC was chartered under Joint Aeronautical Commanders Group (JACG), through Aviation Engineering Board (AEB), to provide a framework for coordination and cooperation in support of JACG Process Improvement Boards. The Air Force, Navy, and Army rotate as the JPCC Chair. The current JPCC membership includes the following organizations:

- Air Force: Propulsion Product Group Manager
- Navy: Director, Propulsion & Power Division
- Army: Chief, Propulsion Division
- Federal Aviation Administration (FAA): Manager, Engine & Propeller Directorate

- National Aeronautics and Space Administration (NASA): Director, Glenn Research Center
- Coast Guard: Chief, Systems Management Branch

The Air Force chairs the PEWG currently, as a recognized special management organization under AFI-21-104, Selective Management of Selected Gas Turbine Engines. The PEWG membership is open to all JPCC organizations, engine manufacturers and suppliers, and other private and government organizations willing to partner with the PEWG program and project activities.

Ms. Lynda Waring, Director of the Propulsion Systems Program Office (ASC/LP) at Wright-Patterson Air Force Base, Ohio serves as the current PEWG Chair.

What Is the PEWG Mission?

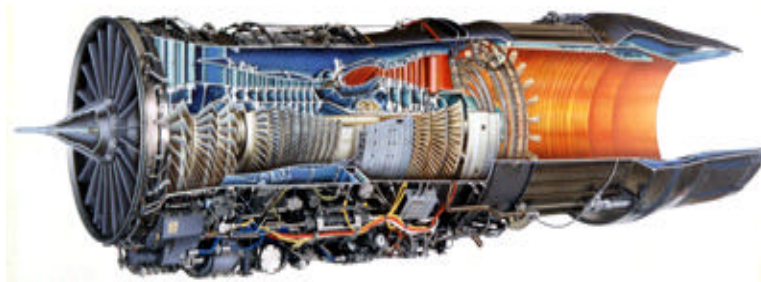
The PEWG's mission is stated in its charter from the JPCC. The mission is multifaceted, but the major thrusts include the following elements:

1. **Understand Aerospace Product Environmental Impacts.** The PEWG will establish correspondent relationships with FAA, NASA and the civilian and military aerospace community (aircraft, propulsion, and power) to fully understand the effect of aerospace systems on the atmosphere and human environment and possible ways to minimize the impacts. Results of these efforts are to be shared through the website, e-mails reports, JPCC presentations, and other methods approved by the JPCC.
2. **Recommend JPCC Actions to Mitigate Aerospace Product Environmental Impacts.** Based on the correspondent relationships described above, the PEWG will perform joint technical and management assessments of issues affecting military propulsion and power to define issues and recommend actions to mitigate environmental and mission impacts.
3. **Implement/Coordinate JPCC Directed Response to Military Aerospace Product Environmental Impacts.** At the direction of the JPCC, the PEWG will seek funding, obtain project approval, and execute actions to respond to identified environmental and mission impacts.
4. **Implement a Joint DoD "Green Engine" Program to "Pull" Advanced Turbine Engine Technologies into Use in Development and Fielded Engine Manufacturing and Repair.** The PEWG will coordinate a propulsion community joint effort to discover, validate, demonstrate, and qualify improved materials, processes, and component designs that will improve performance, serviceability, and environmental security of engine fleets.

How Are PEWG Projects Identified and Executed?

The Process: The PEWG members normally nominate project candidates, based on willingness to collaborate in joint investigations, test programs, and qualification efforts. In support of the PEWG Chair, the PEWG Management Office organizes project teams in planning, budgeting, and, executing approved projects.

The Projects: Projects nominated by the PEWG membership are summarized in this section. Nomination of a project and endorsement by the JPCC does not guarantee funding. Since the PEWG does not have a Program Management Directive with dedicated funding, each endorsed project faces a process of "trolling for dollars" which has been remarkably successful over the life of the PEWG. However, demands on current and near term defense budgets represent new challenges to the quest for project funding.





Current Nominated PEWG Projects

STATUS	PROJECT	PROPONENT(S)
● Complete	Elimination of Class I Ozone Depleting Chemicals from Gas Turbine Engine (GTE) Technical Orders	GEAE; P&W; RR
●	Engineer Substitutes for EPA 17 Callouts in Engine Repair Technical Orders (2 of 3 Phases Complete)	GEAE; P&W; RR
●	Qualify Alternatives to Lead-based Dry Film Lubricants	GEAE; P&W
●	Alternative to HCFC 141B Solvent	GEAE
●	Qualify alternative to zinc chromate primers for GTE wet assembly of GTE fasteners	P&W
●	Demil/recovery superalloy material from engine components— PH I	P&W
● Ongoing	Qualify high performance alternatives to aluminum-ceramic coatings with chromium content	GEAE; P&W
●	Demonstrate electrospray deposition technology applications to reduce chrome plating for engine repair and extend part life	Advanced Surfaces Inc
●	Qualify improved high temperature diffusion coatings to extend life of engine augmentor components	HITEMCO
●	Demonstrate technology and identify applications for thermionic cleaning (improve cleaning performance and increase part survivability without generating solvent or aqueous waste streams)	Edison Welding Institute
●	Qualify HVOF thermal spray coatings to replace hard chrome plating of gas turbine engine manufacture and repair. Develop and implement "producibility" improvements (off angle spray, safe coating removal, spray and grinding best practices, engine oil analysis, inspection methods)	GEAE; P&W; Engelhard; Sulzer Metco; General Atomics; Duval Grinding
● Funded	Qualify engine part substrate restoration via laser cladding	GEAE
● Unfunded	Assess and validate non-spray alternatives to chrome and nickel plating for gas turbine part manufacture and repair <ul style="list-style-type: none"> — Powder coating technology for wear, erosion, and thermal damage resistance — Alternatives to chrome plate using nickel-based chemistry — Alternative to chrome and nickel plate using nanocrystalline Co-alloy pulse plating 	GEAE; P&W
●	Engineer Substitutes for EPA 17 Carcinogen Callouts in Engine Repair Technical Orders (Phase 3)	GEAE; P&W
●	Assess and validate kinetic spray alternatives to thermal and plasma spray processes	P&W
●	Qualify recent advances in thermal and plasma spray process equipment, materials, and methods to replace wet processes	GEAE; P&W
●	Qualify high & low temperature powder coatings for GTE applications	GEAE
●	Qualify environmentally benign Electro Discharge Machining (EDM) fluids	GEAE
●	Qualify hand held laser repair operations	Honeywell
●	Verify oil purification technologies	P&W; GEAE
●	Demil/recovery superalloy material from engine components— PH II	ELG Metals
●	Low plasticity burnishing to extend component life	NAVAIR
●	Inspection through coatings	GEAE
●	Alternative to NiCr ₃ -Cr ₂ plasma powder	GEAE; P&W
●	Plasma transfer arc welding	Edison Welding Institute
●	Electrolytic plasma processing	GEAE
●	Pollutant free high temperature maskants	
●	Qualify advanced blast media	P&W; GEAE
●	Cleaning prior to Eddy Current and FP	GEAE
●	Digital x-ray to replace chemical process	GEAE



How Well Has the PEWG Done its Job?



"So the environmental working group quite honestly has done some fantastic things and they've been recognized many times by both the Air Force Materiel Command and DOD for the technologies that have been developed and transitioned through this working group, and I commend you for that."

Mr. Tim Dues

Air Force Propulsion Product Group Manager

June 2003

"I truly appreciate the effort of this Group in terms of what you're doing to improve engine performance, what you're doing to make it maintainable and doing what needs to be done from an environmental friendly point of view. You've really led the way. This particular community, the propulsion community, has led the way for many others in a lot of different areas."

Mr. Ron Orr

SAF/I&L Office

June 2003

This article was submitted by Chuck Alford, PEWG. ♦

PEWG SUCCESS STORY: QUALIFICATION OF HVOF THERMAL SPRAY COATINGS TO REPLACE HARD CHROME PLATING IN GAS TURBINE ENGINE MANUFACTURE AND REPAIR

Use of chrome electroplating to restore dimensions of worn engine parts has been around a long time – 60 years or more. The process worked well and is relatively cheap, but the material used is toxic – a confirmed human carcinogen. Furthermore, the exposure limits are becoming more restrictive as time goes on. The need for a solution to the environmental issues was recognized by the PEWG. They joined forces with the Hard Chrome Alternatives Team (HCAT) to find an environmentally acceptable alternative that would perform at least as well as chrome plate in restoring dimensional tolerances of worn engine parts.

The PEWG and HCAT proved that high velocity spraying of a blend of tungsten carbide and cobalt powders applied to high velocity oxygen fuel (HVOF) fares far better than chrome plate. The proof resulted from a comprehensive joint materials test



program and tests of actual components in engine endurance and flight tests. Propulsion engineers at the Oklahoma City Air Logistics Center are confident that the HVOF coatings will last at least twice as long. They would like to test to see if the coatings will last three times as long without additional wear. The AF team worked with Pratt & Whitney to use the TF33 engine (B-52 aircraft) as a test subject. Engineers identified seven engine parts to test for coating properties and component endurance. Following the successful test program, the PEWG was instrumental in winning Congressional funding earmarked for Tinker Air Force Base technology transition to create a state-of-the-art HVOF spray facility at the Base. Two booths have been installed and a third is under construction.

The Navy team completed a similar technology transition at its engine depot at Jacksonville, Florida, under an Affordable Readiness Initiative in concert with the PEWG and HCAT. HVOF thermal spray will replace all chrome plating on engines at their depot.

The whole effort began in March 1996 when the Deputy Under Secretary of Defense (Environmental Security) under the Environmental Security Technology Certification Program (ESTCP) initiated a project "Tri-Service Dem/Val of Chromium Electroplating". Under this project, the HCAT was established, with the Naval Research Laboratory (NRL) appointed team lead. A partnership with the Canada Department of National Defense was established to validate HVOF Tungsten Carbide Cobalt (WC-Co) Thermal Spray Coatings as a replacement for hard chrome plating on aircraft landing gear.

From 1996 through 1998 HVOF thermal spray systems were acquired and installed at the NAVAIR Depot at Cherry Point, North Carolina. In April 1999, the Joint PEWG/HCAT project "Qualification of Advanced Thermal Spray

WARNER ROBINS AIR LOGISTICS CENTER IS LEANING INDUSTRIAL PROCESSES WITH POLLUTION PREVENTION

You may be thinking, why does Warner Robins Air Logistics Center, Environmental Management Directorate (WR-ALC/EM) need to get involved in the Lean Initiative? An environmental review would just add time and cost to a process? Well, in addition to the value of cleaner air and water, WR-ALC/EM's participation can help in many ways. In essence, the Directorate has been involved in Lean concepts for the past 15 years – it's just that we called it Pollution Prevention or P2!

Making the Lean-P2 Connection

As you probably know, Lean looks at a process and tries to find ways to make it easier to do our jobs. We want to walk less, wait less, plan better, and have parts when needed. We want to improve productivity by eliminating "waste." Similarly, P2 looks at a process and tries to find ways to make environmental and productivity improvements. P2 improvements are often measured in terms of fewer (or safer) hazardous chemicals, less pollution (waste), and less compliance paperwork. In essence, these are actually process improvements.

The two programs aren't very different, except in what they target for waste. Lean eliminates non-value added tasks to allow more time to do your job. P2 eliminates hazardous materials (HazMats), not just because they end up as emissions, but because they may require personal protective equipment (PPE) and record keeping – both of which add time and cost to a job. Efficient processes use less energy and raw materials, thus reducing per unit production and disposal costs. Because of these similarities, WR-ALC/EM decided to "marry" these programs.

Continued on the next page

Continued on page 18

PEWG Success Story continued

Processes for Gas Turbine Engine Applications” was initiated. A notable feature of this project was the wide range of project funding sources to support this effort, which included the following:

- ESTCP;
- Air Force Material Command Pollution Prevention Integrated Product Team (AFMC P2IPT);
- Oklahoma City Air Logistics Center Maintenance (DMAG);
- NAVY Affordable Readiness Initiative (ARI/W2210);
- Air Force Research Laboratory (AFRL/MLQ - General Atomics);
- T56 Component Improvement Program (CIP);
- TF33 CIP;
- Industry Development Funding (General Electric (GEAE), Pratt & Whitney, Rolls-Royce).

The current status of transitioning HVOF to Air Force engines is summarized in the figure below.

Engine Specific Details for HVOF Transition	
F100 Engine	<ul style="list-style-type: none"> ◆ Not many F100 candidates for HVOF substitution. No core components plated ◆ Current focus: drum rotor, oil wetted bearing compartments - AMS 6265, Impeller shaft; AMS 6265, Gear shaft ◆ CIP repair effort ◆ Engineering validation of drum rotor via similarity to TF33 ◆ Engine test required for oil wetted applications ◆ Planned for Tinker repair ◆ Interest in HVOF coatings as alternative to Gator-Gard
F101/F110/F118 Engines	<ul style="list-style-type: none"> ◆ F110/101 Aft Shaft initially bulk of chrome usage, but non--chrome alternative available ◆ Candidates considered: <ul style="list-style-type: none"> ▪ Disk dovetail, shaft journal, fan blade platform ▪ INCO 718, HPT Aft shaft ▪ A-286, #4 Carbon Seal Seat (recent addition) ▪ SAE 8740, #5 Carbon Seal Seat (potential) ◆ CIP repair effort ◆ Parts previously out sourced to be brought in-house (F101 and F118 Maintenance to Maintenance contracts expiring) ◆ Tinker qualification in work for the F101 2nd stage fan disk ◆ Sample coupons have been coated and evaluated by the Metallurgical Lab ◆ All coating technical requirements fully met. First Procedure Qualification Package for HVOF pending submission to LPA engineering ◆ HVOF repair to be performed in-house on F118 fan blades
T56 Engines	<ul style="list-style-type: none"> ◆ Gearbox components ◆ CIP repair effort ◆ Engineering validation based on Joint Test Protocol results ◆ PBA repair workload ◆ Standard Aero wants HVOF capability but needs price increase ◆ Funding requirement submitted (POM)
TF39 Engines	<ul style="list-style-type: none"> ◆ Applications based on CF6 experience proposed ◆ Chromalloy proponent for PEWG project (April 2004)

This article was submitted by Chuck Alford, PEWG. ◆

WR-ALC... continued from page 16

In the past year, WR-ALC/EM has reviewed over 200 events and was involved in nearly half! Our level of involvement depended on the potential impact to the Environmental, Safety, and Occupational Health (ESOH) aspects of the workplace. We determine potential ESOH impacts by attending events or talking to facilitators. If there is great potential for ESOH impacts, we help lead or facilitate events. It's far easier for us to identify such problems up front than to find out you were in non-compliance later.

Lean-P2 Successful Partnerships

What have been the successes of this partnership? One of the Lean events resulted in moving the F-15 conformal fuel tank maintenance to a new location. From a Lean perspective, the move made sense - the new area had space, trained mechanics, and capacity. The P2 partner identified the ESOH impact that would result by using a new chemical in the proposed location. By identifying this issue early in the Lean process, the P2 partner eliminated a potential compliance problem!

The above partnership was an example where Lean led and P2 supported, but that's not always the case. It's common for P2 to make processes more efficient through Process Specific Opportunity Assessments (PSOAs). P2 improvements often substitute a material or change the process to reduce ESOH impact. You should be familiar with past problems associated with the use of HazMats such as Methylene Chloride and methyl ethyl ketone (MEK). P2 material substitution projects have identified less toxic chemicals as replacements.



Lean vs. PSOA Comparison

P2 also examines new technologies to determine if they can have a positive environmental and production impact. For example, teaming with Maintenance, there is a new system called Flashjet in Building 180 that uses high intensity light to safely strip paint off radomes with the bonus of less damage to the component due to stripping and sanding. Other examples of P2 leading change with a positive Lean impact include the following:

- New room temperature vulcanizing (RTV) adhesives for avionics and gyro shops with lower VOC content and shorter curing times.
- Powder coating in Building 150 to reduce flow days and conventional paint usage in coating operations.

The list of process/technology changes could go on, but you might be most familiar with WR-ALC/EM's work in HazMat management. If you are a shop worker, you're concerned with getting what you want, when you want it, in a size you can use, and how far you go to get it. But ESOH regulations require us to properly store and track chemicals - where, how much, use - which resulted in HazMat Pharmacies. From a regulatory viewpoint, this is ideal with the controlled area and the data-tracking computer. But our Lean partner determined there was a considerable amount of time going back and forth to the Pharmacy.

The Lean analysis at the Building 140 wing shop showed nearly 900 trips a week to the Pharmacy! If a trip covers 600 feet and takes 10 minutes, then just getting chemicals each week took 100 miles and 150 hours. The Lean solution was to install Point of Use (POU) cabinets, which store small quantity/low risk chemicals in work areas. This solution has reduced trips to less than 100 per week, roughly 90 fewer miles, and 130 fewer hours! Since then, over 60 POU's have been put in the aircraft areas alone!



**WR-ALC/EM: Winner of the 2003 Secretary of Defense
Environmental Award for Pollution Prevention -
Industrial Installation**

Now we are looking at the process from start to finish. Having a cabinet in the work area won't do a lot of good if we can't get the proper, fresh chemicals on time in the first place. To help improve the situation, Lean and P2 got together once again. Environmental Management, maintenance, procurement are lining up a Prime Vender supplier. It doesn't stop there, we are looking at streamlining Hazwaste management too, leaning cradle to grave!

Our Lean partners are pleased with less walking to reach the Pharmacy, and we still get the necessary data. But Lean changes, such as POU's, are being re-evaluated for ESOH compliance. The Partnership must benefit both production and compliance. Shop supervisors and workers are still responsible for compliance, even if Lean sometimes reduces ESOH "fail safe mechanisms." The new procedures must be compliant even without rigid ESOH command/control. The last thing we want to see is reversing our Lean/P2 progress by reverting to more restrictions as in days past!

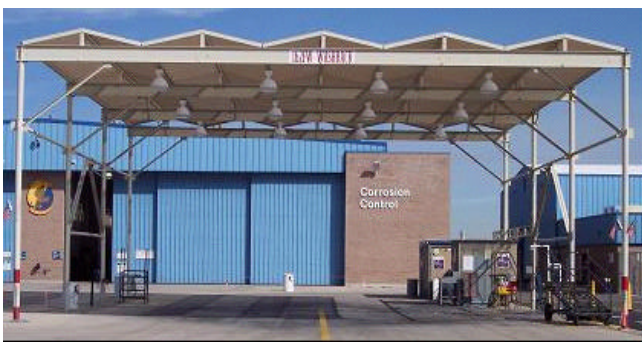
We've only scratched the surface of what Lean and P2 can do together. Robins has an excellent environmental compliance record; Environmental Management will ensure it stays that way. At the same

time, the Lean and P2 partnership results in tremendous process improvements, which enhance our future competitiveness. As testament to that, Robins AFB received the 2003 White House Closing the Circle Award and the 2003 Secretary of Defense Environmental Award for Pollution Prevention-Industrial Installation.

You have been thinking **LEAN** for some time. Now, we hope it will be second nature to think **LEAN and GREEN!**

This article was submitted by Steve Coyle, WR-ALC/EM. WR-ALC/EM's Lean program was also written up in the EPA Publication, EPA100-R-03-005, Oct 2003, Lean Manufacturing and the Environment. ●

SUCCESS WITH CADMIUM SEPARATOR FOR AIRCRAFT WASHRACK



162nd Fighter Wing Aircraft Washrack Facility

The 162nd fighter wing, Arizona Air National Guard, Tucson, Arizona, has successfully implemented a new cadmium separator for the aircraft washrack. MSgt Thomas Hand along with TSgt Rick Slouha have led this effort, resulting in an estimated savings of \$2400 annually in disposal costs for the facility and a significant decrease in hazardous waste production. The decreased hazardous waste changed the base from a Large Quantity Generator to

a Small Quantity Generator under the Resource Conservation and Recovery Act (RCRA), reducing regulatory compliance burden.

Cadmium plating is a corrosion resistant plating added to aircraft hardware. The cadmium plating deteriorates and wears off, especially when the screws are removed. Some of the cadmium particles stay on the planes and some drop to the floor. When the aircraft is washed on the washrack, the cadmium particles are removed into the wastewater. Additional wastewater from cleaning the floors also includes cadmium particles. Both wastewater streams are drained into a modified oil/water separator in the washrack, being used as a wastewater collection bin.

In an effort to remove the cadmium from the wastewater, H.O.D., Inc. the GSA vendor of Moonstone Enterprises water treatment systems was contacted to develop a separation device (photo at right). The wastewater is pumped from the collection bin into the separator, which has 4 tanks. Each tank overflows to the next tank in series.



Cadmium Separator for Aircraft Washrack

Continued on page 23

AIR FORCE PLANT 44 SUPERCRITICAL CARBON DIOXIDE SUCCESS STORY

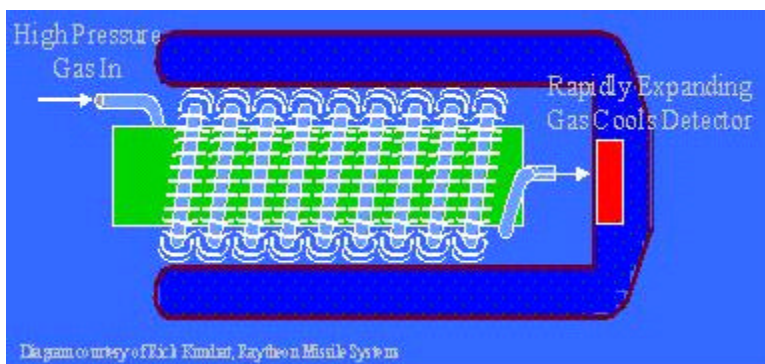
The use of supercritical carbon dioxide (SCCO₂) in cleaning operations has been the topic of multiple projects in the last few years. Raytheon Missile Systems took advantage of one of its many patents on SCCO₂ cleaning technology, originally developed and patented by Hughes Aircraft Company, now Raytheon, in the early 1990s to develop a precision assembly cleaning process for Air Force Plant (AFP) 44. The completed SCCO₂ cleaning system has been in use at AFP 44 since November 2003. The project received a Raytheon EH&S Innovation Award as well as an Operations Excellence Award.



SCCO₂ Receives Two Raytheon Project Awards

“Better, faster, cheaper, cleaner, greener, and safer,” is the motto cited by Richard Padilla, Director of EH&S for Raytheon Missile Systems, when discussing the technology. “The overall partnership with the Air Force, Raytheon, and operating organizations focuses on meeting everyone’s major P2 concerns,” Padilla adds.

Precision assemblies used in space applications have stringent cleaning requirements. Previously, solvent rinsing and vapor degreasing processes cleaned the parts. These processes lead to excess solvent usage, a high cost for specialty solvents, large releases of VOCs, and were time consuming. As an alternative, the Aeronautical Systems Center used Weapon System Acquisition Pollution Prevention funding for Raytheon to implement the cleaning process at AFP 44. The process was specifically for use on Cryostats with plans to integrate that process



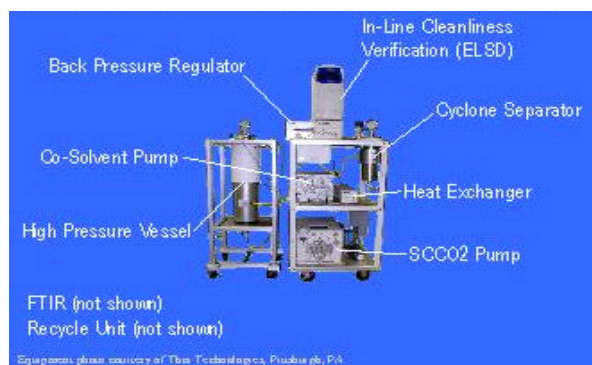
Generic Cryostat

with a contaminant monitoring system. Cryostats are small heat exchangers, highly sensitive to residues, used to cool seeker detectors.

SCCO₂ is an excellent solvent for complex geometries, penetrating like a gas, but with a density like a liquid with a wide range of solubilities for holding contaminants.

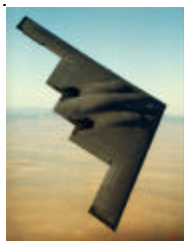
Materials & Process Engineers Julie Stasiak and Hunter Rosen were responsible for the successful implementation of the technology at AFP 44. In the designed process, liquid CO₂ at 800 psi is pumped

to a heat exchanger, heating to SCCO₂ conditions. The SCCO₂ then flows through the cryostat tubing. The SCCO₂ exiting the cryostat is throttled through a needle, forming a dispersion of droplets that can then be flash evaporated in a heated tube, leaving behind a residue. In addition to the SCCO₂ cleaning process, Raytheon implemented an Evaporative Light Scattering Detector (ELSD) in-line with the process to provide real-time monitoring of the cleanliness levels. The residue of soils left behind is moved on to a detection cell where light from a laser beam scatters to produce a signal on the detector. This provides immediate feedback to the system. An in-line view cell for Fourier Transform Infrared Spectroscopy (FTIR) is the next step in moving forward in the process. FTIR uses spectroscopy to identify the soil, aiding in monitoring vendor compliance for unapproved lubricants and cutting oils.



SCCO₂ Cleaning Equipment Diagram

Paul Fecsk, Raytheon's AFP 44 P2 Program Manager, cites the project benefits to be, "an 85% reduction in cycle time for cleaning the cryostats, elimination of the lengthy and energy consuming drying step present in solvent based cleaning, reduced dependency on VOC containing solvents by 80%, resulting in \$30,000 per year savings." The overall cost savings per year are anticipated at \$107,000. The payback period for the project is less than one year. Dick Lantis, ASC's P2 Program Manager for AFP 44, comments, "the technology is very useful in lowering overall VOC emissions at AFP 44 and has applicability anywhere throughout DoD where a cleaner is needed to penetrate blind holes like a gas and hold contaminants like a liquid." Potential further applications of this SCCO₂ technology are in accelerated out gassing and optics. The possibility of using SCCO₂ for larger cleaning operations exists, but the current costs associated with large pressure vessels and high-pressure pumps leave the process better suited for smaller parts. ●



THE MONITOR ON INTERNET

This issue of the MONITOR is available on the Internet at: <http://www.ascenv.wpafb.af.mil>. The current issue of the MONITOR is a Portable Document Format (PDF) file which requires a reader program for viewing or downloading. The Adobe Acrobat reader is available for downloading at no cost. Historical issues of the MONITOR are also available at the above website.

Success with Cadmium Separator continued from page 20

The cadmium separation process includes the following steps:

- 1) A liquid metal precipitant is added and the contents are stirred, overflow to the second tank.
- 2) Two hoppers dispense a coagulant and a flocculent. The water is stirred to begin the encapsulation process, overflow to the third tank.
- 3) The water is further stirred to complete the flocculation and encapsulation process. The water and the encapsulated flocked material overflow to a transfer tank.
- 4) A pneumatic pump sends the water and encapsulated material to filtration socks rated at 75 microns. The socks contain the material and clean water drains out of the filters past a water meter to monitor the daily amount processed.
- 5) A carbon filtration unit is used as a final filtration method before transfer to the Publicly Owned Treatment Works (POTW). The material in the filter socks has passed a Toxicity Characteristic Leach Properties Test (TCLP) and can be disposed of as non hazardous waste in the local landfill.

Below are photographs of the water before and after treatment in the separator and the material removed from the filter socks.



The disposal cost prior to the installation of the separator was 35 cents per gallon. The cost of the products used in the separator, including shipping, to treat the waste breaks down to a figure of 28 cents per gallon. This is a savings of 7 cents per gallon.

278 aircraft have been washed since the installation of the new system in the fall of 2002. There is a potential to transfer this technology to any place where an oil/water separator is being used in a similar fashion. ◆